

# Implementing Green Roof Projects at the Local Level

Webcast Transcript

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# Webcast Agenda and Meeting Logistics

## Slide 1: Title Slide

Operator: Good afternoon. My name is Tasha and I will be your conference operator today. At this time, I would like to welcome everyone to the Implementing Green Roof at the Local Level Conference Call. All lines have been placed on mute to prevent any background noise. If you should need assistance during this call, please press star then zero and an operator will come back online to assist you. Thank you. Ms, Patel, you may begin your conference.

Neelam Patel: Thank you, everyone, for joining us today for EPA's webcast titled Implementing Green Roof Projects at the Local Level. This webcast is being hosted on behalf of the EPA, the U.S. EPA Heat Island Reduction Program, as well as the U.S. EPA Local Climate and Energy Program.

## Slide 2: Webcast Agenda

Neelam Patel: Today, I will begin the webcast, Neelam Patel. I am the green – excuse me – the Heat Island Reduction Program manager and also a team member of the U.S. EPA Local Climate and Energy Program. I will introduce both of these programs, the concept of green roof and also webcast logistics.

Following my introduction, David Sailor, from Portland State University will be presenting the energy performance of Green Roof. Then we will have Jason Berner from the U.S. EPA talking about one of the significant environmental benefits of Green Roof, the Storm Water Management element. Following Jason, we will have Sarah Loveland from DC Greenworks discussing different Green Roof incentive programs that can be implemented at the local level, and also covering briefly some programs that describe the connection between NGOs part and – describing the connection between NGOs and local governments to help support Green Roof implementation. And lastly, we will have a live case study – we'll have Michael Brookshire from the city of Chicago talking about the different Green Roof initiative programs that the city of Chicago has and their success.

After all of these presentations, we will have a question and answer session and you'll hear more about this question and answer session shortly, but I would like to iterate at this time that you are welcome to submit questions at anytime using go – anytime throughout the webcast using GoToMeeting and it would be great if you could indicate the presenter that you would like to direct the question towards.

So I would like to turn it over to Nikhil from ICF International who will go through some of the GoToWebinar logistics.

## Slide 3: GoTo Webinar Software Logistics

Nikhil Nadkarni: So just a couple of quick logistical points here. You will be muted throughout the webcast to minimize background noise. The webinar is being recorded and the files will be posted and available in a few weeks at the URL you see on your screen. And if you have any logistical question and problems today, contact Lauren Pederson at [lpederson@icfi.com](mailto:lpederson@icfi.com). Next slide, please.

#### Slide 4: Questions (GoTo Meeting)

Nikhil Nadkarni: As Neelam mentioned, please submit questions, you know, throughout the webcast, using the GoToWebinar window. You should see a pane titled questions on the right side of the screen. You can type in your question and submit them by hitting Send. We will be collecting the questions, and as time permits, we'll be asking them at the end of the webinar. Be sure to direct your question towards a certain panelist, you know, just by including their name in the question. Next slide, please.

#### Slide 5: Optional Feedback (GoTo Meeting)

Nikhil Nadkarni: And at the end of today's webinar, a pop-up will appear with a couple of quick feedback questions. So please take a minute to fill those out, since your feedback will be most helpful. And that's all for logistics.

Neelam Patel: OK. Thank you, Nikhil.

# **U.S. EPA Heat Island Reduction Program and U.S. EPA Climate and Energy Program**

## Slide 6: Title Slide

Neelam Patel: So, today's webcast, Implementing Green Roofs at a Local Level. The topic of Green Roofs is very important when it comes to heat island mitigation, and you'll hear more from David Sailor about that, specifically, shortly. But Green Roofs are also this – the ability of Green Roof to reduce the heat island effect also helps address climate and energy issues. So we really did want to, in conjunction – in partnership between the Heat Island Reduction Program and the Climate Energy Program bring to you information about Green Roofs so they can be implemented at the local level.

## Slide 7: Outline

Neelam Patel: In my presentation, I will provide a brief overview of the heat island effect, a brief introduction to Green Roofs, talk a little bit about heat island implementation, and then talk about the resources from both our U.S. EPA Heat Island Reduction Program and our U.S. EPA Local Climate and Energy Program.

## Slide 8: Heat Island Effect Overview

Neelam Patel: So starting off with, "What is a heat island?" So, the heat island effect is actually a micro scale phenomena. In dense built-up areas, the temperatures are much higher. In some cases, the temperatures in urban areas that are densely built-up can be as high as 9 to 27 degrees warmer than surrounding rural areas. So, the reason that we get this micro climate temperature increase in more densely built-up areas is because there's reduced vegetation, there's a lot of infrastructure, and the surface is a lot of roof and pavement. And the other issue is the design.

So the urban geometry, there is little room for air circulation to move that heat away from these areas and so we end up having the heat island effect.

## Slide 9: Energy and Air Quality Impacts

Neelam Patel: Some of the impacts from these higher temperatures in densely built up areas is increased energy use in summers. So, the electricity demand can be 5 to 10 higher – 5 percent to 10 percent higher in areas that have the heat island effect, that exhibit the heat island effect. This, in turn, puts a stress on the electrical grid.

So with this increased energy (usage), there are other issues as well. So for example, there are increased greenhouse gas emissions from the energy source, so for example, if you're powering your city with a coal power plant, you are in turn – by having to use more electricity – you are in turn increasing greenhouse gas emissions that go out. There's also increased air pollution both from the power plants and also the higher temperatures increase the rate at which ground level ozone forms. So we do have impacts to both air quality and greenhouse gas emissions.

## Slide 10: More Impacts

Neelam Patel: Other impacts are related to water quality. There's two issues that I'd like to discuss with water quality. The first one is that the runoff in these densely built up areas is actually warmer and that leads to ecological shock in the waterways that receive the runoff water. And the second issue, that we'll hear more from Jason about, is that there is just more runoff from these – from areas that are densely built up. So many of the mitigation strategies cannot only reduce heat island effect but they can also reduce the amount of stormwater that is being runoff.

Other impacts include health impacts and there's many existing health conditions that can be exacerbated by higher temperatures. And there's also symptoms from high temperatures that can affect human health. One of the main things that we are concerned with is actually heat-related mortality in extreme heat events.

And because of the higher temperature, the higher maximum temperatures in densely built urban areas, there is the possibility of a higher heat related death. And this is something that heat island mitigation strategies can help reduce but we can also – an additional resource to help with that public health planning when it comes to (excessive) heat island is available through the link that you see on your screen. So there are many impacts from the heat island effect.

## Slide 11: Mitigation Strategies

Neelam Patel: So, what we focus on through our program is providing information on mitigation strategies that can reduce the heat island effect and have multiple benefits. Here on this slide, you can see that we have four main mitigation strategies that we support with scientifically sound information. Of these four, cool pavements is still an emerging technology but there is a – there are innovative technologies available for cool pavement. What I have done is focus only on Green Roofs for today's webcast but as you can see in the title of mitigation strategies, there is an appendix at the end of the presentation that briefly discusses each of these mitigation strategies.

## Slide 12: Green Roofs vs. Cool Roofs

Neelam Patel: I will focus quickly with a comparison of Green and Cool Roofs and then talk specifically about Green Roofs. So if a local government is looking at roofing as an option to mitigate heat island effect, there are two options, Green Roofs and Cool Roofs, and each one has different benefits. Today, I'll focus on Green Roofs. In some cases the initial cost for Green Roofs can be higher compared to Cool Roofs, but the Green Roofs offer additional environmental benefits that you'll hear about through the webcast.

## Slide 13: What is a Green Roof?

Neelam Patel: So now, I'm moving into "What is a Green Roof?" And I think through these pictures on the slide you can see that a Green Roof is very much having a vegetative surface on a building, and these are great and densely built-up areas where there's lots of buildings and you can – excuse me – yes, lots of buildings, and you can see here in these pictures that this Green

Roof breaks up the built infrastructure by adding vegetation and that lack of – by adding vegetation, we're addressing one of the causes for the heat island effect.

So, the types of Green Roofs are extensive Green Roofs and intensive Green Roofs. Extensive Green Roofs require less soil and there's less maintenance. Intensive Green Roofs, on the other hand, have larger plant growth and a greater soil base that's required. And they also require more maintenance. So you'll hear more about the different projects and examples through the webcast today to get a sense of what could work if you were interested in implementing Green Roofs in your community.

#### Slide 14: Green Roofing Market

Neelam Patel: And so, I just would like to take a second to talk about the Green Roofing market. There are many, many roofs so – and lots of square feet of roofing which is being replaced. So, even if a fraction of these – of the roof replacements were replaced with Green Roofs, we would have – we have a very large market. The point of the slide is that there is a large Green Roof market because lots of roofs are being replaced, and thinking in terms of square feet, three million square feet of commercial roof are retrofitted annually.

So if even a fraction of this surface area were to be replaced with Green Roofs, it would have a significant environmental impact, but also that shows that there is a huge market for Green Roofs. So the more programs we have out there, the more we can implement Green Roofs.

#### Slide 15: Green Roofs

Neelam Patel: Here are some benefits of Green Roofs, and many of these we are going to go through on the call today. But some things I'd like to talk about quickly from a practical perspective are the benefits of Green Roofs include increasing the roof lifespan, in addition to reducing the heat island effect and reducing stormwater. So, it is just a good opportunity.

There are some disadvantages and – that leads to additional upfront cost. But looking at the benefits and the disadvantages are important for a local entity to balance out or a local building to balance out. And so, you'll hear more about that in some of the examples today.

#### Slide 16: Roof Types

Neelam Patel: So there are multiple different types of Green Roofs. And you can see flat roof were in the earlier picture, there's shallow sloped roof, steep sloped roof and this emerging trend of having green walls which are more basic in their structure.

#### Slide 17: Setting up a Green Roof

Neelam Patel: So when thinking about Green Roofs and implementation, there's a couple of things to cover here and think through and I'll cover those here. You have to think about installing a drainage system, the different layers of the roof, the types of soil that you will use,

the types of plants, how you'll plant these things and then maintaining these. And depending on the amount of investment, you can make the decision to go with the intensive or extensive type.

#### Slide 18: Setting up a Green Roof (2)

Neelam Patel: And here is a diagram to show you some of the factors that need to be integrated into a Green Roof.

#### Slide 19: Using Native Plant Species

Neelam Patel: When thinking about implementation, an important element of that is deciding on the type of vegetation that you will use. I just want to quickly mention using native plant species. This is a smart strategy for a couple of different reasons, but mainly it comes to maintenance and cost because it would be easier to manage by using local species – excuse me, native species. They're already able to grow within the local environment.

#### Slide 20: Heat Island Reduction Implementation Activities

Neelam Patel: So that's a little bit of an introduction to Green Roofs and just bridging the gap, when you're implementing Green Roofs into your community, there's a couple of different ways.

#### Slide 21: Urban Heat Island Mitigation and LEED

Neelam Patel: There is the LEED rating system that – when you're looking and thinking about design, you can get credit for Green Roofs through the LEED rating system.

#### Slide 22: Implementation at the Local Level Activities

Neelam Patel: And then other implementation considerations include for a Green Roof and heat island reduction, generally, is that if you're thinking about Green Roofs, you can integrate them into your planning processes from many different perspectives. They can be part of a climate strategy, an energy conservation strategy, a sustainability strategy, they can be a part of green building efforts, and they can be part of climate adaptation, stormwater and air quality programs. So depending on how you would like to implement, you can work with the air quality folks, you can work with stormwater mitigation folks, you can work with energy conservation, the building, you know, efforts. There's many different ways to creatively integrate Green Roof into your work at the local level.

#### Slide 23: Heat Island Reduction – Voluntary Efforts

Neelam Patel: So just very quickly, you can take different steps to integrate Green Roofs and one way would be voluntary efforts. Today, we'll hear about – through the city of Chicago's presentation an award program and a demonstration program, but there's many ways to get these projects on the ground.

#### Slide 24: Heat Island Reduction – Policy Efforts

Neelam Patel: Another option to get these projects going is through policy efforts. The Green Building Programs and Standards is a very effective way to integrate Green Roofs into the work that you're doing at the local level.

#### Slide 25: Heat Island Funding – Climate Showcase Communities Grant

Neelam Patel: The last implementation concept I'd like to mention to you is funding. And while it's rare that there's funding that comes out specifically for heat island mitigation, there are creative ways to integrate the Green Roof concept and other heat island mitigation concepts into different grant program projects. And one example of this is a grant program that's run through the local climate and energy program. And this particular grant, the Climate Showcase Communities Grant, allows applicants to submit projects that essentially reduce greenhouse gas reductions, and this covers a range of activities. And heat island management is one of these categories that can be considered for this grant program.

So while the main focus of this grant program is to reduce greenhouse gas emissions, you can integrate heat island reduction, specifically Green Roof projects, into the project. So this grant, we've had for one year and we're going to be announcing a funding opportunity for the second year some time this – some time very, very soon and when I say soon, I mean, any day.

#### Slide 26: U.S. EPA Heat Island Reduction Program

Neelam Patel: So with that, I'd like to switch over to talk briefly about the Heat Island Reduction program at EPA and our program is a communication infrastructure that works with policy-makers, program designers, the implementers, research – researchers that have information that can help get different mitigation strategies implemented on the ground including Green Roofs. We also support the general public.

Topics that we address are heat island science, modeling, measurement and mitigation strategies such as Green Roofs.

#### Slide 27: Heat Island Connections with other Programs

Neelam Patel: I made this point before but I would like to just reiterate that, heat island mitigation and Green Roofs can be connected to a variety of programs and here's a list of the different types of programs that you can look at and one of the things I would like to emphasize here is that you can make connections to public health programs.

#### Slide 28: Key Program Features

Neelam Patel: Through this program, we have a couple key program features, we have a website that provides a calendar of events, Heat Island in the news – this is a news article that covers Heat Island issues and a science corner where you can get new science.

#### Slide 29: Database



Neelam Patel: We have a database that you can see here, there's a link at the bottom of the slide. Here you can access examples of different heat island projects and if there's any Green Roof projects out there, for which you are looking at building energy conservation or overall atmospheric temperature reduction; we'd like to include your example here in this database so please let me know.

#### Slide 30: Compendium

Neelam Patel: We have a compendium of strategies and you can see that there's a chapter on Green Roofs that talks about the different Heat Island mitigation benefits.

#### Slide 31: U.S. EPA Local Climate and Energy Program

Neelam Patel: And in addition to the Heat Island reduction program, we also have some resources through our EPA Local Climate and Energy program. The goal of this program is to really help local governments reduce greenhouse gases while achieving multiple sustainability goals and through this program, we help maximize multiple benefits, this includes cost savings, public health, economic growth, and having – securing local energy.

#### Slide 32: Local Climate and Energy Program Approach

Neelam Patel: So again, this multiple benefits framework allows you to attain many different goals – air quality improvements, energy security, quality of life.

#### Slide 33: Local Climate and Energy Program Resources

Neelam Patel: And here again, through this program we have many, many resources that can help today's audience on different types of projects that are related to climate and energy and that focus on greenhouse gas mitigation. So here, we have a website, you have a link to our website. We offer regular webcasts and you have a link to our webcast page; our next webcast is on transportation control measures which will be later in June and that date will be posted on the website as soon we confirm our speakers.

We have some resources for economic recovery and the grant that I mentioned. There's more information is available on the web for our grant and we have a series of local climate strategy guides. And again, this is just a quick list of the resources. If you see at the top of slide, see appendix B. There you can find more information about the resources.

#### Slide 34: Local Climate and Energy Webcasts Widget & iTunes

Neelam Patel: So, today's webcast is going to be recorded, Nikhil mentioned earlier, what we will do with the webcast is have it on our iTunes channel, as you see here, for download and we will also have the presentations available online. The other thing we do for our webcasts is we have a widget that you can download to your own websites to inform you of what our upcoming webcast will be. So if you're interested in learning about other topics related to local climate and energy issues, please visit the site.

#### Slide 35: Contact Info

Neelam Patel: So here are the contact information for both of these programs, here we have the Heat Island program which is me, Neelam Patel and then for the Local Climate and Energy Program, I have listed our contacts, Andrea Denny who is the lead for the Climate Showcase Communities Grant Program, and then my other colleague, Emma Zinsmeister who helps support the program.

#### Slide 36: Appendix A and B

Neelam Patel: So you can see that the appendixes are attached to your presentations for more information. So with that quick overview of the programs, the resources, I would like to introduce our next speaker, and that is David Sailor from Portland State University. David is a professor in engineering and he is also the director of the Green Building Program at Portland State University.

He has a long history of research with Urban Heat Islands and more recently, he has been involved in the building scale heat island reduction and today, he'll be talking about Green Roofs; so as David gets his presentation up on the screen, I would like to remind you to please submit your questions for me and the other presenters as they come up and include the presenter for which your question is directed. So, we will have David on here shortly.

# **Energy Performance of Green Roofs: the role of the roof in affecting building energy and the urban atmospheric environment**

Slide 1: Title Slide

David Sailor: OK. I'm here, is my first slide of my presentation being projected?

Neelam Patel: Yes, it is, David.

David Sailor: OK, I'm ready to go then. Hi, so thank you for inviting me to speak today at the webinar on Green Roofs, it's a pleasure to be able to talk a little bit about some of the work that I've done as well as highlight some of the work that others have done in this field.

Slide 2: Why Green roofs?

David Sailor: So, Neelam did a really good job of giving the overview of some of the benefits of Green Roof and so the focus of my presentation is just on one aspect which is the energy balance on the rooftop of a Green Roof and how it impacts both the energy consumption of the building but also the urban Heat Islands. So I'll start by talking about the impact of Green Roof on the building and its energies.

Slide 3: The Building Sector

David Sailor: To provide some context, the building sector is responsible for something like 40 percent of all energy consumption in the U.S. and a similar fraction of a nation's CO<sub>2</sub> emissions. Of this energy use, on the order of about one third is for heating and cooling demand in buildings. So, this leads us to seek ways in which we can reduce HVAC energy used in buildings. In the context of this presentation, the natural question then is what role can Green Roofs play in reducing building energy usage?

Slide 4: Causes of Heating/Cooling Loads in Buildings

David Sailor: To answer this, we need to first consider the various factors that contributed – that contribute energy use in buildings; these include things such as in-door energy use, energy used to condition air that infiltrates the building, solar heat gained through the windows and significantly in back buildings, HVAC load as windows tend to transmit on the order of 50 to perhaps 80 percent of the instant solar energy, conduction of heat through the walls and then finally, conduction of heat through the rooftop. So as this inventory suggests, the Green Roof can play a role but by themselves, Green Roofs are unlikely to make a huge dent in the building's overall energy bill.

Slide 5: Heat Transfer on a Green Roof

David Sailor: So, to understand better the role of the Roof in the conduction of heat to the building, I'll give a brief overview of the energy balance on a Green Roof. To start with, the energy provided by the sun is the major input of energy to the system. The plants then intercept and reflect some of this radiation. The radiation that makes it to the surface of the growing media is partially reflected. Some of the absorbed energy at the surface is convected away as sensible heat and some is omitted as long wave radiation.

Some of the converted – some of the energy is then also converted to latent heat or evaporative cooling through both evaporation from the soil surface but also from transpiration from the plant surfaces. And finally, to balance this energy that is not taken away from that surface is conducted into the growing media and then partially absorbed by the growing media and stored in the soil and finally some of that actually makes its way into the building.

#### Slide 6: Conventional Roof

David Sailor: So how does this play out in terms of impacting the roof top surface temperature and heat flux into the building? To start with, let's consider this as a simple conventional roof top with perhaps a darker membrane, so a darker membrane during, let's say, a hot summer day will typically absorb quite a bit of the solar energy instant upon, it heating up to say, 120, to perhaps 150 degrees Fahrenheit. At night time, however, since the membrane has relatively little thermal mass typically above an insulation layer, it will actually emit long wave radiation readily and cool off fairly rapidly at night.

#### Slide 7: “Cool” White Roof

David Sailor: In contrast, a white roof, or what they refer to as a cool roof, will not heat up as much during the day because it reflects so much larger a fraction of the solar energy but it will also have the same sort of effect at night, where it will emit its heat out to the environment fairly readily and cool off substantially at night.

#### Slide 8: Green Roof

David Sailor: So a Green Roof, in contrast to both the other roofs, measurements in modeling show that the surface of a Green Roof actually does typically remain fairly cool, like the white roof, on a hot summer day and so this means less convective heat flux into urban environment which of course, impact the urban Heat Island. Of course, the Green Roof has stored a great deal of that energy during the day and as a result, will stay warmer at night and possibly conduct some of the stored heat into the building and certainly convect more heat into the urban environment at night.

#### Slide 9: Studies/Measurements Introduction Slide

David Sailor: So, to illustrate these conceptual descriptions of how the Green Roof impacts the surface energy balance, we can look at various measurement studies. I've compiled a few here.

#### Slide 10: Study 1

David Sailor: The first one is an example from some suite of test roofs that were conducted at Penn State University and if you look at the trace of measurements of surface temperatures, these are all for the month of July back in 2003 – summer time temperatures – and what you see clearly is that during the daytime, the roof surface is cooled substantially, say 30 to 40 degrees cooler than a traditional roof during the same time. At night, however, as the – as the area highlighted over here, the Green Roof remains warmer because as I've said, it stores more heat.

#### Slide 11: Study 2

David Sailor: And a similar sort of study at the University of Central Florida, researchers from Florida Solar Energy Center found similar results. They also measured heat fluxes in addition to temperatures and we're able to show that the Green Roof significantly reduces conduction into the building during the day but does result in unwanted flux of heat into the building at night. Due – and again this is due to the stored heat in the growing media and that's shown here in this red box down below.

#### Slide 12: Whole Building Energy Use

David Sailor: So several measurements of roof temperatures and fluxes do not give a complete picture of how a Green Roof will actually impact the energy of this building. So that's – as this slide suggest, the roof top heat flux interacts with things like the internal loads of the building, thermostat and occupancy schedule, infiltration and ventilation, and seasonal weather conditions.

#### Slide 13: Green Roof Model

David Sailor: So, to investigate these sorts of interactions, we found it necessary to actually develop a comprehensive model that represents the physics of what's happening on a Green Roof and then integrate that with a building energy simulation model. So this Green Roof model that we developed includes the way in which vegetation shades the roof from solar radiation and also interacts with the long wave radiation leaving the surface of the rooftop and it also includes the evaporative cooling effects of the green roof and the way in which vegetation affects the near surface wind speed and hence the convection of heat; of sensible heat into the environment. The model also captures the role of heat storage and transport in the soil that depend significantly on the level of moisture on the soil.

#### Slide 14: Green Roof Energy Model Summary

David Sailor: So we developed that model and implemented it in a building energy stimulation software package called EnergyPlus. So as of April 2007, our model was standard in the standard release of EnergyPlus from the U.S. Department of Energy and the inputs for the model are the standard source of parameters that you would use in any building energy simulation software package in terms of things like building details and schedules.

You need to have a weather file but you also need the additional inputs that describe the Green Roof itself, the various design parameters, the leaf area index, the types of vegetation, the height

of vegetation, the density and also precipitation data and whether you're irrigating the roof. The model output then presents hourly building electricity and natural gas use and so, by integrating a physically based model and then validating it with the observed data that we found from various projects around the country; we are now able to quantitatively estimate the impact of any Green Roof on any building in any climate.

#### Slide 15: Example Simulation

David Sailor: So just as a very quick example, we've done simulations for a large number of different types of buildings; this one happens to be just a simple residential two-story building in London. If you look at the impact in the graph in terms of the cooling electricity saving of the Green Roof relative to a conventional roof, of course, you see what you'd expect which is a significant cooling energy savings in the summer. However, there's a portion of the year in the other months in particular where they store heat in the building actually contribute to increased electricity for air conditioning.

And if you look more specifically, just at the hourly consumptions over the course of a single day in, say, in June as shown here – even though the net effect of the Green Roof is clearly a reduction in electricity for cooling, it's interesting to note that the thermal map of the roof actually leads to a small cooling penalty in the early morning hours. This is more than compensated for by the savings in the afternoon and evening hours but it's important to recognize that you have these tradeoffs going on both diurnally across a single day but also across the seasons.

Now what's particularly interesting in this example is that if you look then at the predictive annual heating energy savings of the Green Roof relative to conventional roof, you actually see a fairly substantial gas saving – again it's associated with the fact that the roof – a Green Roof adds insulation in the winter so it has benefits both in summer and in winter, in contrast to something say like, a cool roof that would have a large benefit in summer and a small penalty in winter.

#### Slide 16: A Green Roof Energy Calculator

David Sailor: So that tool is great for us but one thing that we recognized was that in order to use that kind of tool you really need to have building energy modeling expertise. And we wanted to create a tool that was more accessible to those who were not energy modeling experts and so we are in the process, with funding from the U.S. Green Building Council, of creating a simplified Green Roof energy calculator.

And so what we do is we used the detailed energy model that we've developed for EnergyPlus, that's a model – a large number of proto-typical building, we've – so far we've isolated 100 North American cities that we're looking at and for each prototype building, we stimulate a large variety of Green Roof implementations and also conventional and cool roof control cases to compare the performance again. And so we used the model output then to populate the database and – sorry about that – and we used that database then to drive this – what will be a web-enabled resource so that the user can fairly, simply, essentially interpolate within that database to represent the type of roof that they're interested in exploring.

## Slide: The Urban Heat Island

David Sailor: So switching gears now, to talk a little bit about the Urban Heat Island effect, of course all of this – this whole discussion that I'm engaging in here is focused on the energy balance of the roof top and so obviously, the way in which a Green Roof impacts the building is going to impact the building energy use but also the heat then convected into the urban environment and so there's clearly a Heat Island impact potential.

And so if you look at this – this figure here just gives you the general sense of what the various contributors to the Heat Island are, and Neelam already went over this. So in particular, a Green Roof has the potential to provide both evaporative cooling on the building rooftops surfaces, and to modify the sensible heat exchange as I suggested having benefits in terms of reducing sensible heat during the day but perhaps a penalty in increased sensible heat at night.

Another thing to note is that a lot of Heat Island mitigation strategies focused at the near surface, whether it's paving or street trees, both cool roofs and green roofs focused at roof top level which, in a city, can be hundreds of feet above the ground level. And so its impact on the near surface thermal environment is not as significant.

## Slide 18: Green Roofs and the UHI – Portland Oregon

David Sailor: So, I wanted to highlight a few Heat Island studies that have happened in the past decade. The first one is a study that we were involved with, where we were looking at how green roofs might impact the Urban Heat Island of the city of Portland. Specifically, the city asked us the question what impact might there be if the entire Central East side industrial district were redeveloped to include 100 percent green roofs over the next, say, 50 years?

## Slide 19: Results: Heat Island Reduction

David Sailor: And so what we did was we applied a regional or mesoscale atmospheric model and the modified region in our domain is shown here with the red dash line. We ran this model for both the control case but then also for a case in which every roof top in the region was modified to be a green roof and – if my video works here – you can look at the temperature perturbation associated with the green roof over the course of the day. So those contours were just 2/10ths of decreased contours, and what you find out is that in the peak of a summer day, massive greening of the roof tops in that region could reduce peak air temperatures by about one and a half degrees Fahrenheit.

## Slide 20: Green Roofs and the UHI – New York City

David Sailor: Moving on to a study that was conducted by some researchers at Columbia University – well, what they did was they used remotely sensitive thermal images of the surface of New York City. They combined that with land use data to estimate the potential for green roofs to reduce surface temperatures, and what they found was that green roofs could reduce average surface temperatures by nearly one degree Celsius. And while this result is important,

we tend to be more interested in the air temperature Heat Islands and their approach was not able to estimate that. So that's the one question mark in terms of their modeling.

#### Slide 21: Toronto Canada – Control Simulation

David Sailor: In a third study, again this is a study somewhat similar to the one that I presented as the work that we had done in Portland. Brad Bass and colleagues at the University of Toronto and Environment Canada also used a regional-scale atmosphere model. What they did, first of all, was they represented the current positions in Toronto – as sort of a baseline.

#### Slide 22: Temperature change with green roofs and urban vegetation

David Sailor: Then they modified the model to include a combination of green roofs and urban vegetation. So this was not exclusively a green roof study but rather a combination of green roofs and urban vegetation at the street level. And this figure shows the – I'm sorry – a contour plot of the temperature differences between the green case and the control. And their results suggest that the combination of both green roofs and urban vegetations could reduce urban temperatures – urban air temperatures by one to two degree Celsius, but that – what part of that was due to the green roofs is not entirely clear because they didn't isolate the green roofs in the study.

#### Slide 23: PV and Green Roof Integration

David Sailor: And finally, I want to sort of segue into a little discussion of some ongoing research that we have going on here at Portland state. This is an NSF-funded project that confronts the notion that the rooftop design decision is sort of an either or issue where you have to decide, "Do I want a green roof?" Or, "I want a white roof," or, "I want to put photovoltaic panels on my roof."

So in this study, we're specifically looking at potential synergistic interactions between photovoltaic panels and green roofing located underneath the panel. And the basic premise is that the panel efficiency will improve as the green roof lowers the effective operating temperatures of the panel. At the same time, the shading of the panel may benefit both vegetation health and diversity in what is otherwise a rather harsh environment on the building rooftop.

#### Slide 24: Energy Balance Graphic

David Sailor: And so this graphic simply suggests the energy balance we're looking at.

#### Slide 25: Roof design affects sensible heating of the urban environment

David Sailor: Some of our early model results in looking at what the rooftop design decision does to the sensible heat release in the urban environment show that, of course, a traditional roof dumps a lot of heat into the environment during the daytime on a hot summer day. Both the white roof and the green roof, they'll dump less heat, perhaps about 50 percent less during the



day. However, green roof will actually store heat and release it at night so it releases more heat at night than either traditional or white roof.

#### Slide 26-27: Pictures

David Sailor: And so here are a couple of pictures of our initial study site. We have four of these trays each with four panels, and we've recently seeded them. We've got sedum now, or several species of sedum growing. And we're still early into the project, but it should have some interesting results by the end of this summer.

#### Slide 28: Some final thoughts...

David Sailor: And so just to wrap up, just some summarizing comments, final thoughts here. The energy performance of green roofs depends upon many factors; growing media, plant coverage, plant type, building characteristics, weather conditions which include, of course, geographical location. Also the green roofs not only impact air conditioning, but in many applications, have even more important impacts on wintertime heating loads.

I'd also like to draw attention to the fact that the energy performance depends very much on what you choose for your control or your baseline that you compare them against, whether you're comparing against a traditional roof, a dark roof or a cool roof matters. And finally, green roofs can contribute to the heat island mitigation but this is complicated by thermal storage issues which result in more nocturnal heating in the urban environment than other roofing alternatives. And so – I'm sorry.

#### Slide 29: Questions?

David Sailor: So with that, I'll conclude and I do welcome questions, of course, at the end of the session, but also feel free to contact me by my e-mail if you have any lingering questions. That concludes my presentation.

Neelam Patel: Thank you, Dave. That was an excellent presentation that presented a balanced view of using green roofs for both energy conservation as well as heat island mitigation.

And as I mentioned in my presentation, it is important to think about heat island mitigation especially – and including green roof from the multiple benefits prospective. And we focus in on two multiple benefits up to this point, but our next presenter, Jason Berner, will talk about the stormwater mitigation benefits of green roofs. And before we get into that, I just want to reiterate to please send in your questions with the presenter that you would like to answer, address it to the presenter that you would like to answer the question.

# Green Roofs: Stormwater Management and Urban Heat Island Mitigation

Slide 1: Title Slide

Neelam Patel: So we have Jason Berner from EPA's Office of Water, Office of Science and Technology on the call today. Most recently, Jason has been working on developing a draft for the stormwater mitigation rule which looks at modeling – stormwater benefits of low impact development. And one of these benefits includes Heat Island mitigation, but what we'd like to do is focus in on the stormwater benefits of green roofs which we know is a concern for many local-level governments. Jason?

Slide 2: Jason Berner

Jason Berner: All right, thank you. So this first slide, I'm going to sort of skip over since we did that introduction.

Slide 3: Outline

Jason Berner: So my presentation, I'm going to cover on the impacts of stormwater runoff and some of the benefits that can be accrued from green roofs, and looking at different applications of green roofs, and how they can be used for stormwater mitigation, and some analytic and design tools for green roofs.

Neelam Patel: Jason, this is Neelam. Could you make your presentation full screen?

Jason Berner: Yes, sorry about that.

Neelam Patel: No problem.

Jason Berner: Is that better?

Neelam Patel: Yes.

Slide 4: Water Quantity Impacts: Changes in Land-Water Linkages

Jason Berner: OK, great. OK. Yes, so with stormwater management, one of the things that EPA looks at in how the stormwater discharges increase with urban development is how land uses are changed by what is the natural ground cover to the amounts of impervious surface that increases with urban development, as you go from what would be perhaps a forested area to low density residential to medium density to what would be like an ultra urban environment.

So as the amount of development increases, which is the same as the amount of impervious surface cover increases, you have less of the natural hydrologic cycle taking place, so you have less evapotranspiration from vegetation and the amounts of infiltration of precipitation into the

landscape. And as developments or impervious surface increases over the landscape for a given watershed, you're going to have increases in the amounts of stormwater discharges that go into your streams, lakes and other water bodies. And as that occurs, there are different types of environmental degradation that occur, including channelization of streams and increases in nutrient loads and heavy metal.

#### Slide 5: Green Roof Overview

Jason Berner: So, just a quick overview of green roofs, when we talked about how they can enhance or restore what the natural hydrologic cycle was on the landscape before developments occurred and with – and how that happens you're – essentially, you're replacing what would be conventional roof tops or impervious surfaces with different types of vegetation and soil media that can retain certain size storm events. In D.C. some of the small storm events can be from .25 to .5 inches. And another related thing is that by having the green roof on the buildings, you can have differences in the amounts or the temperatures on the outside of buildings.

#### Slide 6: Types of Green Roofs

Jason Berner: This is just a quick recap of what are the types of green roofs. So you have extensive and intensive and there are also hybrid green roofs where you're mixing the extensive and intensive green roof materials.

#### Slide 7: Applications of Green Roofs

Jason Berner: OK, so where can we put green roofs? Well, almost anywhere where you want to, but some of the places that we look at for stormwater program is where can they – where, with new development, redeveloped sites, or retrofitting existing buildings.

#### Slide 8: Benefits of Green Roofs

Jason Berner: And then when we look at the benefits of green roofs from a stormwater standpoint, we're wanting to know what are the overall reductions in flow in the volume of stormwater that go into your streams or lakes, other water bodies and then what are the associated reductions in pollution loads, such as nitrogen or phosphorus. And when you have different types of vegetation on green roofs, you are increasing the local site biodiversity, so you're increasing habitat for different species. Another benefit by having a green roof is that it allows stakeholders or people that use the buildings to know more about how water is managed on their site so they care a little bit more than when it just goes to storm drain.

#### Slide 9: Benefits of Green Roofs

Jason Berner: Couple of other benefits, maybe a little less stormwater-related but still important is that you can increase the aesthetic appeal of the property with a green roof. You can have less maintenance cost or replacement cost compared to conventional roofs and there are some incentive programs or tax incentives where stormwater utility fees can be waived if you have less impervious surfaces for a given building.

#### Slide 10: Examples of Green Roofs

Jason Berner: So I'm going to show a couple of examples of green roofs in the country. This first one is of the American Society of Landscape Architects in Washington D.C., which is a commercial retrofit. And this is sort of a cool example in that they were trying to figure out, you know, different ways that they could use an extensive and intensive green roof and they were monitoring the differences in temperature from their buildings to surrounding buildings and also recording the amounts of precipitation that was retained for a given summer to fall period. So for one period of record, they found out that they were able to retain about 76 percent of the amount of rain from the summer to fall season.

#### Slide 11: Examples of Green Roofs

Jason Berner: This next example, I'm not going to talk about this too much because we'll go into it in more depth. But this green roof at City Hall of Chicago is pretty important in that it was one of the first major retrofits for an institutional building or any building in the U.S. And they looked at the – they looked at using 150 different species of plants and they recorded that this green roof was able to retain 75 percent of a one inch rain event which is – for most areas one inch rain events can cover between 85 to 90 percent of all rain events throughout a given year.

#### Slide 12: Examples of Green Roofs

Jason Berner: OK. And this last example that I have, this is more of like an urban planning view of or a regional view of how you can plan out, how green roofs are implemented for Washington, D.C. This is Casey Trees and LimnoTech did this D.C. green build-out model and they looked at different scenarios of how intensively they could use green roofs, and also a tree canopy to catch our stormwater runoff. And they looked at – they looked at it at different time periods and found out that there could be up to a 10 percent reduction in stormwater runoff in Washington D.C.

#### Slide 13: Tools & Resources for Green Roofs

Jason Berner: The last couple of slides, I'm going to talk about tools for designing green roofs and also modeling them. Green Roofs for Healthy Cities, that's an industry website that you can get up-to-date publications and look at what conferences are going on or trainings. And then EPA, we have a couple of websites where you can look at not only green roofs for their performance and different design templates, but you can also look at rain gardens or porous pavements. So, there's a suite of what we call BMPs that can be integrated with green roofs.

#### Slide 14: Tools & Resources for Green Roofs

Jason Berner: And this next slide, this gets into more of the models that we use for assessing the benefits of using green roofs. So there is the EPA SWMM model and a newer model which is called SUSTAIN. And SUSTAIN is a GIS-based version of SWMM, and you can design from a one acre or smaller parcel of land up to – at the neighborhood scale and see how you could use

green roofs, but also other BMPs to see how you could reduce pollutant loadings and the amount of stormwater coming off of a given site.

Lastly, there're some stormwater calculators, which are simple versions of some of the EPA models, where you can figure out conceptually like how much – if I did a green roof of a certain size for a given parcel of land, what would be the general reductions in stormwater runoff and general reductions in nutrients. Virginia – State of Virginia has a spreadsheet called the Virginia Runoff Reduction Method, where they're looking at primarily how they can reduce nutrients to the Chesapeake Bay with different green BMPs such as green roofs.

Slide 15: Thank You, Questions??

Jason Berner: And that's all for me. That is my contact information and we have a website where you can keep up to date with the stormwater rule that we're currently working on. We're looking primarily at green infrastructure and low impact development design technology such as green roofs for that rule.

Neelam Patel: Great. Thank you, Jason. That was a great overview of the stormwater perspective on green roofs. And again, if you have questions for David or Jason, feel free to email them or submit them to us, using go to meeting, and we'll answer them during the question and answer session.

# Green Roof Incentives + Partnerships – The 2010 Resource Guide

## Slide 1: Title Slide

Neelam Patel: I'd like to go ahead and introduce our next speaker. At this point, you've heard about the science and some of the many benefits of green roofs and factors that need to be considered if you are interested in implementing green roofs. So, what we'd like to do is transition into implementation from an incentive perspective.

Today, we have Sara Loveland on the call with us. She is a board member of D.C. Greenworks and will cover some of their interesting projects and work that's coming out of this nonprofit organization, D.C. Greenworks. Recently, she has been involved in organizing the regional green roof meeting that was held last week here in Washington D.C. There were several hundred attendees that were interested in learning more about green roofs from the industry side and the implementation side. So we're going to ask Sara here to talk about some of the work that D.C. Greenworks has accomplished recently. Sara?

Sara Loveland: Thank you. I'm really excited to be here today and also to see that we have over 200 people on the line, so I think that's a really great turnout and I'm happy to see so much interest. So we have a lot of information to cover in a very short time and I'm going to move quickly through it.

## Slide 2: Our Mission

Sara Loveland: At D.C. Greenworks, our mission is to grow livable communities using living materials so you can see that that's quite broad.

## Slide 3: Our Business Model: The results of a business with the heart of a non-profit.

Sara Loveland: Under that umbrella, we do a number of different things and that includes consultation, installation, advocacy, training and research. And you're really going to hear about the installation and sort of consultation as well as the research today.

## Slide 4: DC Greenworks Government Partnerships

Sara Loveland: Now, one of our interesting partnerships with the government of the District of Columbia is the Washington D.C. Green Roof Pilot Subsidy Program. So in the district, the D.C. government doesn't administer these programs directly, so they have NGO partners to do that for them. We originated the Pilot Subsidy Program in 2007 and it provided for \$3 per square foot for every green roof installed.

And there was an approval committee and a rating system because originally, we thought there was going to be very fierce competition and so we wanted to promote, you know, sort of the best projects, demonstration projects and public access and things. As we realized that the industry

was shifting and the demand was different than we thought, we evolved the program. It now provides for \$5 per square foot of green roof installed, and it has a much more prescriptive criterion, so 50 percent coverage of usable roof space.

Now interesting thing to note here, because many legislators across the country are struggling with what percentage they'd like to incentivize, is that we're looking at 50 percent of usable roof space, which excludes any HVAC equipment on the roof and also any skylights. So you could do anything around with – excluding those square footage. And then it also prescribes three inches of growing medium depth.

#### Slide 5: DC Greenworks Government Partnerships

Sara Loveland: Another one of our great government partnerships was funded by the Office of the Deputy Mayor for Planning and Economic Development. This is a very targeted sort of eco-district program and it's called, "Green Roofs for Environmental and Economic Revitalization." As you can see, we've gotten that into a real cute acronym. But the main goal is to target a revitalizing commercial quarter in the city where there are a lot of buildings that have long been neglected, and that are undergoing renovation at a very rapid pace right now. So we want to make sure to incentivize them as much as possible where we have an opportunity to get, you know, almost a greenway through the middle of the city with some really great linkages to other natural resources.

So for that, we're providing \$9 per square foot. And again, because these funds don't come from the same pot of money as the district department environment funds, the clients can use both of them, so you've got your \$9 per square foot plus a \$5 per square foot. And then this grant also provides for D.C. Greenworks to manage and to design, and manage and build the project with volunteers for the community so that's how we sort of leverage our funds and make sure that we can get people who are interested on the roof and get them some training, and then also provide all these services that are really low-cost for the building owner. This project was funded last year and we're still working on sewing up all the available funding for it.

#### Slide 6: The 2010 Resource Guide

Sara Loveland: So the next thing that I'll talk about today is the 2010 resource guide. This is – was compiled over the course of 2009, so the data is current through September 2009. It was funded by the Chesapeake Bay Small Watershed Grants from the National Fish and Wildlife Foundation and the goal was to get a snapshot of what's going on in the industry, what different incentive programs people are offering, and hopefully, make some recommendations based on what we see is working and, you know, what we see being implemented on a wider scale. So a best practices paper in short.

#### Slide 7: The Need

Sara Loveland: A lot of people have gone over the need for these different incentivized programs, but I do feel it's important to throw out these numbers that we're looking at. Forty million people are living in 32 states, including the District of Columbia, and 746 cities that have

combined sewer systems. And you can see these numbers here which are just staggering, that amounts in over 9,000 outfalls which dump 850 billion gallons of untreated sanitary sewage into our waterways every year. And there – you can obviously see the also staggering numbers of how much it's going to cost to remediate that.

#### Slide 8: The Need

Sara Loveland: Now, the other thing that's interesting to note is that all of these cities and private entities as well have violated the Clean Water Act over 500,000 times since 2004 and fewer than 3 percent of these violations resulted in penalties. So I think that the EPA is really stepping up on enforcing a lot of these as a regulator, but it's important to talk about the incentives as well, which is why we're here today.

#### Slide 9: Top Ten Metropolitan Area List by Square Footage of Green Roof Infrastructure Installed, 2008

Sara Loveland: So these are the leaders as you look across the metropolitan areas. I'm sure many – metropolitan areas in the United States, I'm sure many of you have seen these. So Washington D.C. always comes second to Chicago, we just can't seem to get up there and those are fighting words for our part, because in D.C., we hope that next year we'll be number one.

#### Slide 10: Green Roof Incentives in the United States

Sara Loveland: So here's what we looked at. We did sort of a survey based on an AIA study that was conducted in, let's see, 2009 and we got a list of all of the different public policies that incentivize green buildings. So some of these are specifically green roofs and some of them are green building as classified by the U.S. Green Building Council, which, of course, is the most popular legislative mechanism for Green Building Acts in cities. And so it's really interesting, I think, to take a look at where these incentives fall and there are quite a number of incentives as you see indicated by the dark green. And then a lot of major metro area incentives as indicated by the larger green dots.

#### Slide 11: population of United States municipalities with green roof incentives

Sara Loveland: Now, here's another interesting point. The population of the United States that is covered by these regulations is really quite large. So using 2008 estimated populations, there were jurisdictions of anywhere from 13,000 people to over 8 million people who took the opportunity to implement Greenworks' incentives of some type. And this is land area ranging from 2.2 miles to over 2,000 miles, but I think the really astounding number here is that 42 – almost 42 and a half million Americans live in cities that support green buildings and 38 million live in cities that have implemented incentives to expand green roof and green building technologies that does not include state-incentive programs.

So, if your city is not one of the numbers, keep in mind that these programs, hopefully, will be coming to you and hopefully, you'll be bringing them to your populations, because it is growing now. I always like to give a shout out to Eagle County, Colorado, which was one of the



jurisdictions of just a few thousand people who took it upon themselves to enact very progressive legislation.

#### Slide 12: Incentive Implementation by Region

Sara Loveland: So, here's what the incentive implementation looks like by region, and I think probably not very many of you will find this surprising that the west, where there are water shortages, and the northeast where there is extreme pollution are the leaders impacting this policy. There's not very much going on in the southwest. We do see a lot of growth in the southeast as well, and you can see this on the next slide where you look at the number of policies implemented by year.

#### Slide 13: Year of US green roof incentive implementation

Sara Loveland: So, 1996 wasn't a very big year. In '97, there was nothing going on. And then, you see the numbers start to peak in 2004, was when it really built to that sort of critical mass where you see every year we've got new direct and indirect and also some intangible incentives introduced.

#### Slide 14: Incentive Options

Sara Loveland: And I'll explain to you how we divide those up here. So, we have direct monetary inducements, I think you guys are familiar with some of these if not in green building in other areas of policy, grants, tax credits, tax abatements, other loan formats. Then there are indirect financial incentives and this includes things like fee reductions and storm-water utility fee credits. And then we covered intangible incentives, so this is alternative density bonuses, fast-track permitting, awards and expedited utility hook up, or things like that that help you get your project done more quickly, and allow you to build more usable space and more – add more value to your building.

I mean, and there's also, of course, the stick to counteract the carrot, so there are definitely – there's definitely legislation being enacted as well, but again, we're going to stay on the carrot today. And also, you know, I'd to take this opportunity, before I get into a little bit about each of these categories, to remind you that at the end of this presentation, I'll show a slide with a link to the D.C. Greenworks website where you can download the full White Paper. It's 45 pages, so obviously, more than I can cover in 15 minutes. And I strongly urge all of you to go and to download the White Paper, and just share it with other policy makers.

#### Slide 15: Direct financial incentives – Tax Incentives

Sara Loveland: So, the first of our direct financial incentives are tax incentives. There are 15 green building and two green roof specific tax credit or abatement programs around the country in the bills that we've highlighted here, New York City and Philadelphia. New York City provides one-year tax abatement for at least 50 percent coverage.

This program is a little bit slower getting up and going, they've only had five applications so far, and a lot of this is for people who are using public space, other BMPs, and not necessarily green roof. And as far as I know, after the close of this study, there was one application that went through for a green roof in late fall of 2010. If anybody is on the line who's from New York and you have more current numbers, that would be awesome if you'd share.

And then, in Philadelphia, we also have tax credits for the lesser of 25 percent of project costs or \$100,000 against the Business Privilege Tax. This program also has only had one applicant, so it's just getting going.

#### Slide 16: Direct financial incentives – Grant Programs

Sara Loveland: And we have grant programs. There are 17 programs that fall under, you know, one of four structures. So a lump sum per project, this is where you would say, "We'll give you \$5,000 if you build a green roof," and that's basically as specific as it gets. There is an amount per square foot with or without a project limit. That seems to be one of the most popular programs that we're seeing right now because it just seems very static. So you can sort of prescribe some of the things that I covered with the Washington, D.C. subsidy. A certain number of dollars per square foot, you'd like a certain amount of coverage, and you expect a certain amount of soil depth as well.

And another way to incentivize along those same parameters would be to use a percentage of the total project cost. So if you have really good data about average cost by building type for your city, you could target specific building owner constituencies using these percentage costs to figure out how you get to – the number that we like to see is usually 25 to 30 percent of the project cost to really make it worth their while, to truly incentivize.

And then you see them as an element of a larger grant program. So I talked about our greeNER Program in Washington D.C. Also Portland, Oregon has a Community Watershed Stewardship Grant that can be combined with other grants. And so you can leverage a lot of grant programs with each other. And we hope, of course, that you'll also do that with community involvement and, you know, private donations and building owner contributions as well.

#### Slide 17: Direct financial incentives - Loans

Sara Loveland: There are nine loan programs available right now, most of which focus on energy efficiency but will fund the green roof. Two of them are green roof specific. So the Bronx Environmental Revolving Loan Fund is one of the most frequently highlighted. So it's a low-interest loan, it started in 2006. And there are really capable terms for this. \$100,000 is the maximum loan and the interest rate is one to three percent. And I don't know how many of you have been looking at loans recently, but a one to three percent interest rate is virtually impossible to find. So this has funded 13 green roofs and approximately 40,000 square feet of vegetative space.

Now, another note that wasn't included in the study but that we've seen some tremendous movement on in the past year are Property Assessed Clean Energy financing programs. Now,

these use your property tax assessment, and so they add the loan to the value of the building and it is transferred with the ownership of the building rather than with the loan. So it comes on your tax bill is how you pay this. Really interesting programs, we have one most recently enacted in Washington D.C. several months ago. Annapolis, Maryland enacted one. It's also very popular in jurisdictions across the West Coast right now.

#### Slide 18: Indirect financial incentives

Sara Loveland: Also indirect financial incentives, so here, we're going to see things like reduced fees for Green Building permits. Or, let's say, if you have a green building fund as in Arlington County, which is a suburb of Washington D.C., while you're building your project, you contribute 4.5 cents per square foot to a green building fund. If you achieve your LEED certification, you're refunded that money. If you don't, that money stays in the fund and can be used for other projects.

In Minneapolis, property owners can apply for a credit of up to 50 percent of their stormwater utility fee if they're using best management practices and can also apply for credit for quantity measures, so that includes green roofs as well.

#### Slide 19: Intangible incentives

Sara Loveland: Other intangible incentives – 13 Density Bonus Programs, I think this really speaks to the value of real estate in the urban cores – a lot of people just want to build more space. If you tell them they can do that when they do a green roof, it's going to be a very popular program. And Fast Track Permitting is also a very popular program. 20 Fast Track Permitting or Priority Permitting Programs are implemented across the United States.

So none focused specifically on green roofs, but if you are applying for a permit for a green roof or your green roof is a component of a green building, then you're going to realize those benefits as well. Now, I've heard mixed reviews from jurisdictions across the country. Some people are saying, "Yes, our green building permit expediting program is working." And some people say, "No, you know, we haven't really seen it working yet. It's more an exercise in theory." So also, you know, if any of you'd like to contact me, I'd love to hear feedback about the efficacy of these programs in your jurisdiction.

#### Slide 20: Impervious Surface Fees

Sara Loveland: I just have a couple of notes about impervious surface fee logistics for a minute. If you don't have impervious surface fees in your jurisdiction, you should be asking for them. This is the polluter pays model. So, in most cities, we've been paying for our stormwater runoff by our water consumption, which means that a Wal-Mart with a large parking lot that doesn't use a lot of water is going to have a very low stormwater utility bill. But we want them to have stormwater utility bill that's related to the amount of impervious surface they have as you can see - as indicated by this map here.

#### Slide 21: Impervious Surface Fees

Sara Loveland: So this is what we've done in DC. We have an Equivalent Residential Unit that makes it very easy to quantify across just residential – the typical, sort of residential lot for the city – this city's building stock. Now, the interesting thing here is that those charges are very affordable but they are projected to escalate so this is sort of typical of these programs where you see a small and more affordable fee but there will be fee increases every year. So, 6.9 million annually in fees is nothing – it's a drop in the bucket. We need to fund a 2.2 billion dollar stormwater diversion tunnel; we're also funding ongoing green infrastructure projects. So, it would take 318 years to pay for the tunnels if we just use those fees at the current rate. So, you really have to think about the true cost of your stormwater management. You know, we want to make sure the user pays, or sorry, the polluter pays, and also that the user's paying what the actual cost of the treatment is.

#### Slide 22: Recommendations

Sara Loveland: So out of the paper, we came up with a set of about 10 very general recommendations for – to help you along the way, again, I can't say enough. Please read the White Paper. There are a lot of really valuable insights there where, you know, we talk about how you can do some of these things. But, I'd like to definitely call out that you should conduct some research about the baseline of green roof interest and understanding. Do people in your jurisdiction even know what's going on?

Demonstration projects are hugely important. I think most cities have these now, but doing case studies that come out of those and continuing ongoing research on the performance of those is also very important, and a lot of times, that funding gets value engineered out of the demonstration project without significant public funding.

Also you're going to want to look at formalizing green roof incentive administration and this basically means: appoint a technical assistant supervisor, appoint a green roof specialist position. These people should be, you know, a very easy and approachable point of contact for building owners who are still trying to find their way through learning about green roofs and what it means for their building. Let's make this simple for them. Let's not make it too hard for them to have access to the information they need.

And then continuing to cultivate a culture of urban environmental awareness. This is hugely important and it seems basic thing but, you know, a lot of times our messaging as government entities, or even as private entities, isn't effectively conveying how important these issues are to people in the city.

#### Slide 23: Increase education and outreach of the green roof technology and sustainable green building

Sara Loveland: So, these are some of the tools that you can use to increase the education and outreach. And, we want to see toolkits. We definitely want to see those toolkits on websites. We want all of this information free and easy and accessible. If your jurisdiction doesn't have them yet, again, please refer to the White Paper, but find another jurisdiction that has good toolkits and

great websites for resources and, you know, refer people there. And definitely, you know, waste no time in creating your own.

Also the Green Roof Professional Accreditation from Green Roofs for Healthy Cities, I think, has gone a long way to starting to establish some standard within the marketplace about what the design criteria are and who's really qualified to be up on the roof. Green technology centers and research centers are hugely important to maintaining – you know, you can go on research from another region, but it's not necessarily going to be indicative of the performance benefits and the results of projects in your area, so you want to make sure you start getting that data as soon as possible.

#### Slide 24: Recommendations – The big three

Sara Loveland: Then the big three recommendations that came out of it. We'd like to see an energy star rating for green roofs. We kind of think that, you know if the EPA were to fund at 30 percent, the cost the green roof similar to, you know, what we would do for solar panels or for white roofs, that that would be a great starting point.

We'd also like to see more funding for eco-districts especially in revitalizing neighborhoods or areas where environmental justice has frequently been a concern. We'd like to see a focus on the commercial district and high traffic areas where you'll really reach a lot of the population, and educate them through even just their presence in these areas, but also getting them involved and getting them, of course, as DC Greenworks motto would be, to have the community involved in implementing the projects and taking ownership.

And then we'd also like to see green roof-ready construction. Sort of the example here is in Colorado. There's some recent legislation that mandates that new construction be solar panel ready. So, while you may not have solar panels on them, you – it should be easy for anyone who buys one of these homes to install solar panels. We'd like to see the same thing be implemented for – and this would be enacted as legislation – for building codes that would support, you know, 35 pounds per square foot or depending on the snow load in your area, you know, what the total arrives at. But at least another 35 pounds per square foot for load so that even if the current building owner didn't want to do a green roof, it wouldn't be a massive and very expensive, and prohibitive retrofit project for the next building owner to undertake that.

#### Slide 25: What you can do now:

Sara Loveland: So the call to arms – what we'd like to see you do – any of these certified things. You can install a green roof, if you can't do one yourself, volunteer with the Stormwater group or support businesses that are water conscious. They don't necessarily have to have a green roof. We understand not everybody can do them right now, but learn what water conscious means for different types of businesses and support those who are conscientious. Also urge your legislator to pass supporting policies. It's hugely important. Supporting research in your community, make sure that you know who's doing good research. And, you know, find out how you can help them or how you can leverage their research and build off of it.

Slide 26: Where you can find us:

Sara Loveland: Sorry, I'll go back to the last slide. So here's information about where you can find the resource guide. Do you see [greenworks.org](http://greenworks.org)? It's pretty easy to remember. You can also contact us by phone; you can just show up at our office. The picture at left is one of our greeNEr test spots and we are located next to Atlas Theater in beautiful 8th Street, Northeast corridor.

You can also feel free to reach me via email, [sara@dcgreenworks.org](mailto:sara@dcgreenworks.org). And if anybody has any questions in the question and answer session, I'll look forward to helping out.

Neelam Patel: Great. Thank you Sara. I'd like to move to Michael Berkshire from the City of Chicago and continue on this implementation theme and thinking about what you need to do if you were to implement Green Roofs in your neighborhood; what you need to consider. And what we'll be hearing from Michael is actually the work that Chicago has already accomplished. Like Sara mentioned, Chicago is a leader, sounds like there's some competition between D.C. and Chicago for this leadership role.

# Chicago Green Roof Initiative

## Slide 1: Title Slide

Neelam Patel: As Michael sets up his PowerPoint, I want to take a few minutes to introduce him. Michael Berkshire works in the sustainability office in the Department of Planning for the City of Chicago. He has been involved in the environmental field for 24 years.

He is on the board for the local chapter of the Green Building Council in the Chicago area. And for the City of Chicago, he was on the taskforce in developing the climate action plan. So Michael can speak to you about Green Roof, heat island mitigation, and climate management issues. Michael?

Michael Berkshire: Good afternoon. Thanks so much for inviting me to tell a little story about what we've been doing in Chicago to encourage our construction of Green Roofs. So, for most of the time this afternoon, I'm just going to spend a few minutes talking about our current tool kits that we use, which you'll see is a variety of both sticks and carrots. And there are a couple of grant programs that we had in the past that I would more – I would feel very comfortable in talking about, but I'm not going to spend much time right now. But we can talk about it during the question and answer period. But I'm going to really focus on our current tool kit.

## Slide 2: Chicago City Hall Green Roof

Michael Berkshire: Our first slide is an aerial photograph of our City Hall. So you can see here that the building that City Hall is in is half City Hall; the other side is the County Administrative Office. So only the City Hall side is vegetated in. I just love this photo because it shows the stark contrast between a vegetative roof and a typical black asphalt roof.

And we have been conducting research on temperature differences between the two different roof structures. And on a 90 degree day, the vegetated side on City Hall hovers around 90 degrees whereas the county side, the black asphalt roof, reaches temperatures of over – around 170 degrees at certain points of the day, Fahrenheit. So at certain points of the day, we're seeing about a 90 degree difference between the two sides of the roof. So we are proving that it will impact temperature changes.

## Slide 3: Policy

Michael Berkshire: Really, our driving force behind the Green Roof movement in Chicago has been policy, so more of the stick side. Sorry, this is kind of hard to see, but I would be more than happy to email this to anyone, it is on our website. But this is our sustainable development policy and very simply how this policy works that if you receive any form of assistance on your project – development project in the city, whether that be monetary incentive, such as tax increment financing or if you're buying a piece of property at a reduced price from the city or if you're getting any kind of tax credit – we have very popular industrial tax credit. And then also, if your project is part of a plan development, which means it's a development that exceeds a

certain side whether it's height, square footage, we – it has to go through our department for review. So any of these projects are required to include sustainable elements in them and often times this is – it is a Green Roof.

And this was initially implemented back in 2004. And at that point, it really did primarily just encourage Green Roofs. But in 2008, we expanded the policy. And now if you can see this, we also are requiring LEEDS certification for many of the projects as well as projects that we asked them to exceed our stormwater requirements; energy efficient level – energy efficiency levels, et cetera. So it has been really our most effective tool and driving force behind the number of Green Roofs that we're seeing constructed in Chicago.

#### Slide 4: Stormwater Ordinance

Michael Berkshire: second stick, or regulation, is our stormwater ordinance. It is a newer regulation; it was enacted in 2008. And again very simply, what it states is that you have to keep a half inch of rain on your site, so volume.

And it also – well, there's two ways you can do that. You can keep a half inch of rain. You can provide that through – or prove that through a plan you have to submit or you can increase the perviousness or permeability of your site by 15 percent from existing conditions. And here, not only has it promoted a lot of Green Roof construction but also rain barrels, parkways that are designed to take stormwater as well as a lot of permeable asphalt, concretes and pavers, et cetera.

#### Slide 5: Incentive

Michael Berkshire: And then one of our most successful incentives has been our Green building permit process. As Sara mentioned, quite few cities are implementing this. How it works here in Chicago is that to qualify as a Green building, to go to this program, you typically need some level of LEED certification. But you also have to have either one or two menu items included. And there are – I believe there are around 12 menu items that you can choose from and Green Roofs are one of those menu items. So we have encouraged quite a few projects through that program as well.

#### Slide 6: Incentive

Michael Berkshire: Another successful incentive has been our density bonus. Any project in the downtown area or the central loop area of Chicago, you can build, you know, more square footage, if you include certain amenities and Green Roofs are one of those. I would give – I would – I would – I hope or I wish that it was in a very simple calculation but it's actually a very complicated calculation on what the actual additional square footage you can build based on the square footage of your Green Roof. But it is available on our zoning department website if anyone would like to look at that calculation.

#### Slide 7: Education: [www.chicagogreenroofs.org](http://www.chicagogreenroofs.org)



Michael Berkshire: And very important too is education. We do have a Green Roofs website, [chicagogreenroofs.org](http://chicagogreenroofs.org). We partnered with the School of the Art Institute here in Chicago and a couple of graduate students actually designed this website.

One of the, I think, the neatest features of this, as you can see on the left side of the screen, you can scroll around an aerial photograph of the city and buildings that have Green Roofs – have that green icon. You can click on that icon and information about that Green Roof comes up – you know, whether it's extensive, intensive, the square footage. And if we do have a photograph of the roof, that will show up as well. And we are in the process of updating this website.

#### Slide 8: Green Roofs in Chicago

Michael Berkshire: And so since, you know the – our initiative really began with the construction of the Green Roof on City Hall, which was completed back in 2000, which has also become kind of the icon of not only our Green Roof initiative but also our sustainability initiative in Chicago. It's been very successful. It's been covered in all of the media.

Unfortunately, you can only go up there with a guided tour, but that kind of leads to the interest in it because everybody wants to be able to take a tour up there. And that also points to I think what's been really effective in Chicago, through our green – not only our Green Roof initiative, but also just green building and sustainability is that the Mayor is very interested in the leading by example.

So we try to implement any kind of new initiative or with the city first. And I think having a very successful Green Roof on City Hall has been helpful in asking the private sector to also follow us in some of our efforts. So I think demonstration or, you know, providing demonstration projects as well as leading by example has been a really important aspect to our program.

But all of this has led to – we have over 700 Green Roof projects that are in various stages of development at the moment. Some are still in planning, design and not all are constructed. But once they are constructed, they will total over seven million square feet. And, you know, this is not a static number. It's changing daily as projects come in asking for any kind of assistance. We are just adding to that total all the time.

#### Slide 3: Policy

But I do – I will go back for a minute to talk about the policy. You know, I don't know if this would be an effective tool at the moment to initiate, because of the economic situation. This was first published in 2004 when we had a, you know, a really thriving economy here in Chicago.

But some things that were helpful when we were implementing this policy was that we held a series of focus groups with developers, engineers, architects and also the attorneys that handled projects that would be subject to this policy. And we presented a draft policy to them and received quite a bit of feedback. And at that point, of course, a lot of them were saying that you're going to drive development out of – out of the city, et cetera.

But we did make some modifications to it based on our feedback. One of them was to increase the options for reaching the policy. So we did that. But it was really interesting because once we did publish that policy, I did get a lot of comments from developers saying that they did like it.

Because before they never knew what the city was going to ask for. And publishing this document, they knew before they came in to talk to us what exactly was going to be asked of them. And so they could start building the cost into their pro-formas immediately. And also being open about it, they also knew that they were being treated equitably. You know, they knew that any industrial project that was receiving tips would have the same requirements and that was somewhat a consolation for – I mean, they really did enjoy that. So you do have to take some time if that was something that you're interested in. And you do have to consider the economy at this time.

Slide 9: 168,000 s.f. Fed Ex Building Green Roof

Michael Berkshire: So what I'll end with is this is a photo of actually one of the largest Green Roof projects in Chicago and this is the new Fed Ex building at O' Hare. We're expanding O' Hare Airport and this is 175 thousand square feet of vegetation at that new airport expansion. So with that, I'll conclude. And I look forward to any questions anyone has. Thank you.

Neelam Patel: Great. Thank you, Michael.

## Questions and Answers

Neelam Patel: We actually have a lot of interesting questions that range from technical – the availability of technical models and also to the social and psychological benefits of Green Roofs. So before we go into the question and answer session, I would like to take a moment and go back to a comment that I made in my presentation earlier about the Climate Showcase Communities grant.

Slide 25 of First Presentation: Heat Island Funding - Climate Showcase Communities Grant

Neelam Patel: On the screen now, you should see the slide discussing the Climate Showcase Communities Grant. I mentioned that the grant was going to open very soon. I want to announce to our webcast participants that the grant has just opened. So if you are interested in applying to the Climate Showcase Communities Grant to receive funding to implement projects that reduce greenhouse gas emissions, I suggest that you check out the website. And to get ideas about existing projects, we have the web address for our grant program listed on this slide.

I'm going to take a moment to take you to the website. This is our state and local homepage (<http://www.epa.gov/slclimat/>). And if you look in the "What's New" box to the right, you will go to the announcement, "June 8 - EPA announces \$10 million for communities to combat climate change".

You come to the climate showcase communities homepage and here, underneath the title, you'll see the request for proposals. So once you click on this link, it takes you to the request for proposals and describes the exact requirements for applications. And I will also take you to the EPA homepage.

Here, if you go to the newsroom and then go to news releases, go down to sort by subjects and go down to Climate. You will see the press release that has just come out for this grant program. So now I encourage you to check this out if you're interested in combating Climate Change through mitigation.

And for those of you who are interested in cool roofs and have already done some legwork in your communities – excuse me – Green Roofs, and have already done some legwork in your community, this is an opportunity for you to integrate Green Roofs into projects that can be part of this Climate Showcase Communities Grant Program.

So what I will do now is hand over the question and answer session to Nikhil. Like I mentioned, we have had many questions, great questions. We don't get to all of them, but we will provide written responses to all the questions that we did not get to. So, Nikhil, if you'd like to start off with the questions?

Nikhil Nadkarni: Sure. Yes. Thanks everybody for sending in questions and also for including a name of the panelist. That definitely helps to make sure your question gets answered by the right person. I will start off with some questions for David.

So our first question is one of the attendees is curious to know whether the cooling penalty described is counterbalanced by the lesser demand in the early morning hours. Does this effectively flatten the demand load by shifting the demand to low peak periods?

David Sailor: OK. I assume that the question is in regards to early morning cooling penalties for Green Roofs. Yes. So definitely there is an element of sort of shifting the load, but at the same time, there is just more energy that is entering the building over the evening hours. And so when you first turn the building on in the morning, it will take extra energy to do – to cool it off. So I think there might be an element of shift, but I think there's also a distinct penalty that generally is more than off-set by the reductions in the load during the day itself.

Nikhil Nadkarni: OK. Second question for David Sailor. When will your simplified U.S. GBC Green Roof Model be available for use?

David Sailor: We should have that ready by the end of the summer. We currently have a beta version that we're testing out. We have run several thousand simulations with our initial model. We are finalizing some small modifications to the model and then we'll be running another couple of thousand simulations to repopulate the data base.

But again, probably by the end of the summer, it will be available. And it would be available on our website. You can either find me directly at Portland State. Our Green Building website is [greenbuilding.pdx.edu](http://greenbuilding.pdx.edu).

Nikhil Nadkarni: OK. One last question for David Sailor. How much roof surface must be greened or cooled in order to see measurable or meaningful impact on Urban Heat Islands. Specifically, are there feedback effects of Urban Greening on Urban Heat Islands at large geographic scale? For example, is the impact of 1000 green roofs 1000 times the impact of one?

David Zeller: OK. That's actually a very complicated question and it – it's mirrored by the same sort of question with respect to white roofs or street-level vegetation. And, you know, there are definitely non-linearities in the Urban Climate System to start with. And so, you can't necessarily expect a linear scaling.

At the same time, these complexities yield very surprising results at times. For example, if you look at some of the heat island mitigation scientific literature, you'll find that, you know, widespread mitigation in the city or to just in a region of the city has a general sort of city-wide impact of reducing air temperatures but tends to have complex interactions with the vertical mixing in the urban environment so that you actually have spots where you perhaps have increases in temperature or increases in photochemical smog.

So when you look at – at in the aggregate, you know, it all looks great. But the complexities or the devil is in the details and that you do have – you do have sort of this very spotty non-linear response in the city.

Nikhil Nadkarni: OK. Thanks a lot. We'll move on to some questions for Jason Berner. First of all, does the retention of heat in green roofs increase or decrease based on the amount of water in the roof, is this impact different depending on whether it's day or night?

Jason Berner: I'm sorry. Could you repeat that just one time?

Nikhil Nadkarni: Sure. Does the retention of heat in the green roof depend on the amount of water in the roof and is that affected by whether or not it's day time or night time?

Jason Berner: That is a question that I can't give a definitive answer for, but I can say that the amount of – the amount of time the water is retained in the green roof will affect like the reduction in heat in that water. And when it's released to – if it is released to the storm sewer system that – it's the retention time that will have the greatest effect on the amount of heat or the reduction in heat when that stormwater is discharged. Yes, that's – yes.

Nikhil Nadkarni: OK. A second question. You mentioned that there are possible stormwater utility credit programs for Green Roofs. Would you be able to identify them? Also, has the FEMA community rating system for flood protection recognized the benefits of green roofs?

Jason Berner: Sure. Well, a couple of the incentive programs with utilities; one would be out in Portland, another is in D.C. And in general, with both of those programs, there is a – there's a monetary incentive for the use of green roofs or other LID techniques over conventional practices. And so – and that monetary incentive will – it will range in a lot of the times the type of practice that is used and also what type of property that, say, like a retro fit is put in place for.

For the FEMA flood protection program, I do know that FEMA is looking into having different green infrastructure and LID practices such as green roofs be used for providing monetary incentives for communities to use those practices to lower their flood protection insurance rates. But I believe that that change in their program is relatively new. So I'm not sure if it's actually been enacted nationwide yet. And there was one other question about – was it the NPDES program?

Nikhil Nadkarni: Yes, that's right.

Jason Berner: OK. Can you repeat that one? I'm sorry.

Nikhil Nadkarni: Yes, just have the NPDES programs recognize green roofs for credit?

Jason Berner: Definitely. But I guess it depends on how you view that. So, different localities have turned with their NPDES permits have been actually requiring or having as an option green roofs for meeting their discharge requirements.

So right now, with the NPDES permits, it's really based on if a certain city is just – if their city engineers are educated about these practices and they have confidence that, you know, green roofs will meet, you know, their discharge limits. But, yes, it's definitely – green roofs have been put into NPDES permits.

Nikhil Nadkarni: OK. Let's move on to some question for Sara. Thanks, Jason. So the first question for Sara, how do the incentive programs ensure that Green Roofs are designed and constructed to meet performance standards? Is the performance of a green roof linked to the incentive program?

Sara Loveland: I've never seen a case yet where the performance of the green roof was linked to the incentive program. And mostly I think this is sort of a legislative challenge because you want to get the money out the door to get the projects funded and it would be very difficult to rate the performance over time and tell people that you don't want to pay out incentives until you've proven performance.

And so, as a result, that's why you see some of the things like growing medium debt or specified plant list or gone to the point where some jurisdictions specify particular materials and you hope that that gets it most of the way there. But we do also hope that they're doing research or you know, sort of retroactively.

Nikhil Nadkarni: OK. Second question, would a green roof in an arid area, such as Los Angeles – you know, this is an example from one of our attendees – would a green roof in an arid area require a higher maintenance given the low rainfall and to prevent it from becoming a dust roof? Specifically, would it require irrigation potentially increasing water usage?

Sara Loveland: You know, even if it required irrigation I've seen some interesting studies about what the “net water value” is for that when you talk about the cooling effect that it has on the building and how much that reduces the HVAC demand. So I think the number about whether – there's no straight, you know, black and white answer about whether or not it actually increases the overall water usage, even if you use irrigation. But again, I think getting the right plant types for your climate region and, you know, designing the right system. If you're just doing an extensive system, I don't see why projects would necessarily have to have irrigation.

Nikhil Nadkarni: OK. Third question, could you provide examples of eco-districts around the country?

Sara Loveland: Portland and I believe Seattle will become eco-districts and then there are other smaller grant programs that approach eco-districts but are not quite as comprehensive. So, for example, the green roof for environmental and economic north east revitalization that I spoke about is an area targeted by the deputy mayor and part of the program called the Neighborhood Investment Fund and there are 20 of them in the city.

And I think a lot of cities have these where you've already identified commercial corridors that where the city is, you know, trying to promote business growth. And so we – I guess as an eco-district as a general term, would like to see some of these areas that have already been targeted for economic development also targeted for green improvements.

Nikhil Nadkarni: OK. Thanks, Sara. Let's move on to some questions for Michael. Could you talk about green roofs made from containerized plants and how the cost compared to other types of green roofs?

Michael Berkshire: Yes. Well, there are some really interesting new green roof systems out there. There's Roofscapes down at Philadelphia, they have – it's a built up system. I believe it's, you know, three to four inches in depth. If you – if they can place it on a building that's less than three story, then it has at least 10,000 square feet. I've heard quotes as low as \$7 a square foot, which is the lowest cost that I've heard of.

You know, we see both modular and built-up systems in Chicago. The modular systems are not always less expensive. It depends on the depth, of course, and, you know, where they are in the building, how high the building is, et cetera. And then you also have the hybrid systems such as zero floor, which is more like a mat that is laid out almost like sod, it's kind of rolled out.

So there's really, you know, interesting, new technologies out there. But in general for an expensive roof, so a pretty simple, you know, three to six-inch roof, I would say that the, you know, the average is \$10 to \$12 a square foot and that includes a very simple palette of plants as well. But you know, they range anywhere from \$7 a square foot, like I said, all the way up depending on, you know, if you have water features or et cetera you can get in to, you know, \$30, \$40, \$50 a square foot.

Nikhil Nadkarni: OK, second question, has the city of Chicago experienced any negative results from its green roofs, any unanticipated results?

Michael Berkshire: No, I can't think of any. You know, I mentioned during the presentation that when we were holding the focus groups back in 2003, you know, people were threatening that they wouldn't build, you know, some development with LEED in the city, et cetera. I've never heard of a project where that was the breaking point and they ended up moving out into the suburbs.

And, you know, this whole movement has changed so significantly since 2004 and it's, you know, a couple of anecdotal stories. I work with, you know, quite a few attorneys that deal with the large scale projects that we work with and review. And he said that, you know, back in 2005, 2006, his blood pressure always went up every time he saw me because he would, you know, he knew I was going to talk to projects about, you know, receiving LEED certification and green roofs and he thought, you know, that the price of every development was going to increase after they talk to me.

But I was talking to him about a year ago and he said that now he's always so proud to bring projects into us because developers are, you know, designing buildings that are already LEED certified, you know, that are going to which that are designed to achieve LEED certification, have green roofs, and then you just realize that it's the cost of doing business in Chicago.

And also what's really interesting is that potential buyers or renters are now asking and demanding sustainable elements in buildings. And one developer in particular that I remember

him yelling at me right after we implemented the policy, he came up to me and he said, "You know, if you build a non-LEED certified building at this point it's not going to be worth anything today." So I've just really seen the change in the attitude and I think it's for a variety of reasons. There's more national exposure to all of these things but it just has really become important part of the discussion for any development in Chicago.

Nikhil Nadkarni: OK.

Neelam Patel: OK, great.

Nikhil Nadkarni: And Neelam, I guess, looks like that's all the time we have for questions?

Neelam Patel: Yes, that is all the time we have for questions. We didn't get to all of the questions. So I apologize to our listeners about that but in order to make sure that we have answered all the questions, what we will do is take all the remaining questions and provide a word document that will be posted on the website that was in the presentation. So in addition to accessing the presentations, the audio files, and the audio files on our website, you'll also be able to access a word document, and a PDF document that has answers to all the questions.

I would like to thank everybody for joining today's webcast and taking time to listen in on the potential of Green Roof and what they can do for your community. We heard about many different benefits and the factors that need to be considered as well as the process and considerations that need to be addressed by communities when implementing Green Roofs.

So I want to thank all of our speakers this afternoon and remind all of our listeners that the climate showcase communities grant has been released and we are accepting applications until July 26th. And also remind you that our next webcast will be the last week of June hosted by the local climate energy program on the topic of Transportation Control Measures.

So, on the same website where you can access these presentations from today's webcast, you will also learn about our upcoming webcast. I would like to thank to everyone for listening in and look forward to having you join our future webcast from both the local government climate energy program as well as the heat island reduction program. Thank you.

Operator: Thank you. This concludes today's conference call, you may now disconnect your line.

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